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Original Research Article

A Study on Risk Stratification and Multimodal Prevention of Postoperative Nausea and Vomiting in Patients Undergoing General Anesthesia

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Abstract:

Background: Postoperative nausea and vomiting (PONV) remain among the most common complications following general anesthesia, with significant impact on patient satisfaction and recovery. Risk stratification using the Apfel score and multimodal prophylaxis has been recommended for effective prevention.

Aim: To evaluate risk stratification and the effectiveness of multimodal prevention strategies for PONV in patients undergoing general anesthesia.

Methodology: This prospective observational study was conducted in the Department of Anesthesiology, Shahid Nirmal Mahato Medical College and Hospital, Dhanbad, Jharkhand, over one year. A total of 88 adult patients undergoing elective surgeries under general anesthesia were included. Patients were assessed preoperatively using the Apfel risk score and received prophylaxis based on risk category. Postoperative monitoring for nausea, vomiting, and rescue antiemetics was done for 24 hours.

Results: The overall incidence of PONV was 34.1%. A higher incidence was observed in high-risk patients (50%) compared to low-risk patients (10%). Early PONV (0–6 hours) was more common. Patients receiving no or single prophylaxis had higher PONV rates, while multimodal prophylaxis significantly reduced incidence (18.7%). Rescue antiemetics were required in 29.5% of patients.

Conclusion: Risk stratification using the Apfel score effectively predicts PONV, and multimodal prophylaxis significantly reduces its incidence. A tailored, risk-based approach is essential for improving postoperative outcomes.

Keywords: Postoperative nausea and vomiting, PONV, Apfel score, multimodal prophylaxis, general anesthesia, risk stratification.

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Introduction

Postoperative nausea and vomiting (PONV) remain among the most common and distressing complications after general anesthesia. Despite advances in anesthetic techniques and pharmacologic agents, PONV continues to be a major factor in patient outcome and satisfaction. Nausea and vomiting are among the most common adverse events in the postoperative setting, occurring in approximately 30% of the general surgical population and in up to 80% of high-risk patients. PONV is common, which highlights the ongoing importance of its treatment as a critical component of perioperative care [1].

PONV is not only unpleasant for patients, but also significantly contributes to psychological distress and dissatisfaction with surgical experience. Nausea and vomiting are often reported by patients to be of greater concern than postoperative pain. Moreover, PONV has numerous clinical and economic implications [2]. It has been shown to cause a significantly prolonged stay in the post anesthesia care unit (PACU), an increased likelihood of unanticipated hospital admissions and to contribute to rising healthcare costs. Severe cases can be associated with complications such as dehydration, electrolyte imbalance, wound dehiscence, and aspiration pneu-

monitis, all of which highlight the importance of effective prevention and management strategies [3].

The pathophysiology of PONV is complicated and multifactorial with a range of central and peripheral mechanisms involved. The vomiting center is located in the medulla and receives input from the chemoreceptor trigger zone (CTZ), vestibular system, gastrointestinal tract, and higher cortical centers. Emesis is mediated by several neurotransmitters including serotonin (5HT3), dopamine, histamine, and substance P. The risk of PONV is influenced by patient related factors (e.g., female gender, history of motion sickness or prior PONV), anesthesia related factors (e.g., use of volatile anesthetics, nitrous oxide, and opioids) and surgery related factors (e.g., type and duration of surgery) collectively. These factors require a structured and evidence-based approach for risk assessment [4].

Risk stratification remains the cornerstone of PONV management. Various predictive models have been developed, most popular being the simplified Apfel risk score. This model includes 4 independent predictors: female gender, non-smoking status, history of PONV or motion sickness, and postoperative opioid use. The likelihood of developing PONV increases with the number of risk factors present, from approximately 10% with none present to 80% with all four presents. Such stratification helps clinicians tailor prophylactic therapy to the individual risk of patients, thus optimizing both outcomes and unnecessary exposure to drugs [5].

Management of PONV is a complex process. There are many different antiemetics with different pharmacokinetics, efficacy and side effect profiles. The choice of an antiemetic will depend on the clinical context. The benefit of prophylaxis of PONV must also be balanced against the risk of adverse effects. Institutional factors affecting management of PONV are also cost effectiveness, availability of drugs and formulary policies. Several classes of antiemetics have been shown to be effective: serotonin receptor antagonists (eg, ondansetron), corticosteroids (eg, dexamethasone), dopamine antagonists, antihistamines, and neurokinin 1 (NK1) receptor antagonists, but no single agent has been found to be universally effective. Therefore, a multimodal approach combining agents with different mechanisms of action is recommended especially in patients at moderate to high risk [6].

Although several guidelines have been published for the management of PONV, they often have limitations. Some are only applicable to certain patient groups, some are not a complete guide to all the elements of PONV management, and some are not current with the evidence. Recognizing these gaps, there have been periodically expert groups that have agreed to consensus guidelines that offer evidence-based recommendations. In 2003, 2009 and 2014, our group published three consensus documents for the recognition of PONV, designed to standardize and enhance clinical practice in different health care settings. There were more than 9000 studies identified on a systematic literature search since the last update, and developments in recent years have greatly changed the landscape of perioperative care, including improvements in the implementation of enhanced recovery pathways (ERPs). Therefore, new guidelines incorporating the most recent evidence are very important to improve patient outcomes [7].

The adoption of standardized PONV prevention methods could be influenced by the healthcare environment, access to drugs, patient demographics, and economic factors, which are prevalent in resource variable contexts like Dhanbad, Jharkhand, in the Indian context. The need for region specific data for the efficacy of risk stratification tools and multimodal prophylactic strategies under routine clinical conditions still exists [8].

Hence the object of this study is to assess the risk stratification and feasibility of multimodal preventative measures of PONV in the patients undergoing general anesthesia in tertiary care center at Dhanbad, Jharkhand. The aim of this study is to provide an insight into patient specific risk profiles and the effectiveness of combined antiemetic treatments to help improve the perioperative care for patients and increase their satisfaction.

Methodology

Study Design: This study was designed as a prospective observational study conducted to evaluate risk stratification and the effectiveness of multimodal prevention strategies for postoperative nausea and vomiting (PONV) in patients undergoing general anesthesia. The study was structured in accordance with standard perioperative research methodology and contemporary evidence-based guidelines emphasizing risk assessment and multimodal prophylaxis.

Study Area: The study was conducted in the Department of Anesthesiology, Shahid Nirmal Mahato Medical College and Hospital (SNMMCH), Dhanbad, Jharkhand, India.

Study Duration: The study was carried out over a period of one year.

Sample Size: A total of 88 patients were included in the study. The sample size was determined based on feasibility, patient load, and the study duration.

Sample Population: The study population consisted of adult patients undergoing elective surgical procedures under general anesthesia. Patients were assessed preoperatively for risk factors of PONV using established scoring systems and were followed

postoperatively for the occurrence of nausea, vomiting, and need for rescue antiemetics

Data Collection: Data for the present study were collected using a structured and predesigned proforma. All patients were evaluated preoperatively, intraoperatively, and postoperatively. Preoperative data included demographic details such as age, sex, body mass index, smoking status, history of motion sickness, previous history of postoperative nausea and vomiting, and ASA physical status. Intraoperative data comprised type of surgery, duration of anesthesia, use of volatile anesthetic agents or propofol, administration of nitrous oxide, opioid usage, and prophylactic antiemetic drugs administered. Risk stratification was performed using the Apfel simplified risk score based on four parameters: female gender, non-smoking status, history of PONV or motion sickness, and postoperative opioid use. Postoperative data included the incidence of nausea and vomiting within 24 hours, timing of symptoms (early: 0–6 hours and late: 6–24 hours), and requirement of rescue antiemetic therapy. All observations were recorded systematically and maintained confidentially.

Inclusion Criteria

- Patients aged 18–65 years
- Patients undergoing elective surgery under general anesthesia
- Patients willing to participate and provide informed consent

Exclusion Criteria

- Patients receiving regional anesthesia alone
- Emergency surgery cases
- Patients with known gastrointestinal disorders causing nausea/vomiting
- Pregnant or lactating women
- Patients on chronic antiemetic or steroid therapy
- Patients with ASA physical status IV or above

Procedure: After obtaining informed consent, patients fulfilling the inclusion criteria were enrolled in the study. A thorough preoperative evaluation was conducted, and each patient was risk stratified for PONV using the Apfel scoring system. General anesthesia was administered according to standard institutional protocols. Based on the assessed risk, appropriate prophylactic antiemetic therapy was provided: low-risk patients received minimal or no prophylaxis, moderate-risk patients received one or two antiemetic agents, and high-risk patients received multimodal prophylaxis using two or more drugs from different pharmacological classes such as ondansetron and dexamethasone. Intraoperative variables including anesthetic agents and opioid use were carefully monitored. Postoperatively, patients were observed in the post-anesthesia care unit and surgical ward for 24 hours for the occurrence of nausea and vomiting. In cases where PONV occurred, rescue antiemetics from a different class than those used for prophylaxis were administered. The findings were recorded for further analysis.

Statistical Analysis: The collected data were compiled, tabulated, and analyzed using Microsoft Excel and Statistical Package for Social Sciences (SPSS) software (version XX). Continuous variables such as age and duration of surgery were expressed as mean ± standard deviation, while categorical variables such as incidence of PONV and risk factors were presented as frequency and percentages. The association between risk factors and occurrence of PONV was analyzed using the Chi-square test or Fisher's exact test as appropriate. Comparison between groups was performed using Student's t-test for continuous variables. A p-value of less than 0.05 was considered statistically significant. The effectiveness of multimodal prophylactic strategies was assessed by comparing the incidence of PONV across different risk categories".

Result

Table 1 shows that majority of patients fall under the age group 31-45 years (36.4%), followed by 18-30 years (27.3%). The study population was slightly more female (54.5%) than male (45.5%). Most patients (59.1%) had a BMI less than 25 kg/m². The demographic data indicates a relatively young to middle aged surgical population with a slight female predominance that could also impact the incidence of PONV as female gender is a recognized risk factor.

Table 1: Demographic Distribution (N = 88)

Variable	Category	Number (n)	Percentage (%)
Age (years)	18–30	24	27.3
	31–45	32	36.4
	46–60	22	25
	>60	10	11.3
Sex	Male	40	45.5
	Female	48	54.5
BMI	<25	52	59.1
	≥25	36	40.9

Table 2 Postoperative opioid use (70.5%), non smoking status (65.9%) and female gender (54.5%) were the most common individual risk factors. There were 34.1% of patients who had a history of PONV or motion sickness. This suggests that there was a high proportion of the study population with more than one risk factor, making them more likely to develop PONV.

Table 2: Distribution of Risk Factors (Apfel Score)		
Risk Factor	**Present (n)**	**Percentage (%)**
Female gender	48	54.5
Non-smoker	58	65.9
H/O PONV/motion sickness	30	34.1
Postoperative opioid use	62	70.5

Table 3 shows that most patients were in the moderate risk group (40.9%), with 36.4% in the high risk group and 22.7% in the low risk group according to the Apfel risk score. This distribution shows that the majority of patients had two or more risk factors for PONV suggesting the need for suitable prevention, particularly for patients with moderate to high risk, where multimodal therapy is recommended.

Table 3: Risk Stratification (Apfel Score Categories)			
Risk Category	**Score**	**Number (n)**	**Percentage (%)**
Low risk	0–1	20	22.7
Moderate risk	2	36	40.9
High risk	≥3	32	36.4

Table 4 tells most used prophylactic therapy was dual therapy (38.6%) followed by single drug therapy (31.8%). 18.2% of patients received multimodal prophylaxis (two or more drugs). A minority (11.4%) did not get any prophylaxis. This suggests that the approach to prophylaxis is becoming more risk based, with more combination therapy use among higher risk individuals.

Table 4: Type of Prophylaxis Given		
Prophylaxis Type	**Number (n)**	**Percentage (%)**
No prophylaxis	10	11.4
Single drug	28	31.8
Dual therapy	34	38.6
Multimodal (>2 drugs)	16	18.2

Table 5 shows the overall incidence of PONV in the study was 34.1%, with the majority of episodes occurring in the early postoperative period (0–6 hours). The incidence of PONV increased with the increments in risk category (high risk patients had the highest rate). The rates of PONV were higher in patients who were not given prophylaxis or were given only a single antiemetic than in patients given dual or multimodal therapy. The use of multimodal prophylaxis proved to be effective with a significant reduction in PONV incidence. Further, 29.5% of patients also need rescue antiemetics, suggesting that poor prophylaxis tends to be accompanied by a greater postoperative need for intervention. In general, the results illustrate the significance of risk categorization and also the need for multimodal prophylaxis in the alleviation of PONV.

Table 5: Combined Analysis of PONV Incidence, Timing, Risk Stratification, Prophylaxis and Rescue Antiemetic Use (N = 88)					
Parameter	**Category**	**PONV Present (n)**	**PONV Absent (n)**	**Total (n)**	**Percentage (%)**
Overall Incidence	Present	30	–	30	34.1
Absent		–	58	58	65.9
Timing of PONV	Early (0–6 hrs)	18	–	18	20.5
	Late (6–24 hrs)	12	–	12	13.6
No PONV		–	58	58	65.9
Risk Category	Low (n=20)	2	18	20	–
	Moderate (n=36)	12	24	36	–
	High (n=32)	16	16	32	–
Prophylaxis Type	No prophylaxis (10)	7	3	10	–

	Single drug (28)	11	17	28	–
	Dual therapy (34)	9	25	34	–
	Multimodal (16)	3	13	16	–
Rescue Antiemetic	Required	26	–	26	29.5
Not required		–	62	62	70.5

Discussion

Postoperative nausea and vomiting (PONV) is a common and important complication of GA that impacts patient comfort, recovery and overall satisfaction. Overall incidence of PONV in the present study was 34.1% like the PONV incidence of about 30% in the general surgical population, indicating that the study population had similar perioperative characteristics to those seen in the general surgical practice.

In our study, there was a slight predominance of females (54.5%). Having a female gender has been well established as an independent risk factor for PONV and several studies have shown that the incidence is 2-3 times higher in females than males. Nonsmoking status (65.9%) and postoperative opioid use (70.5%) were also common among most patients in our study and are also important components of the Apfel risk score. These risk factors are like those found by Apfel et al., who showed that the more risk factors the higher the incidence of PONV" [9].

In our study, 40.9% of the patients were in the moderate risk group and 36.4% of the patients were in the high risk group, which means that most of the patients needed active prophylaxis. This is in line with findings by the authors of the study, Gan et al., who found that most surgical patients have moderate to high risk and benefit from prophylactic antiemetic therapy. In addition, several studies have compared predictive models and confirmed that the Apfel score is accurate and easy to use for risk assessment [10].

One of the important results of our study was the correlation between the risk category and the incidence of PONV. The more important result of our study was the clear correlation between the increase of risk category and the increase in PONV incidence. Fifty percent of patients in the high-risk group developed PONV (16/32), whereas only 10% of patients in the low-risk group developed PONV (2/20). This is like previous data collected by Apfel et al. which showed a rise from around 10% to 80% risk of PONV as scores increased. Eberhart et al. also made similar observations, demonstrating the predisposing value of risk scoring systems [11].

As for the use of prophylaxis, our study showed that multimodal prophylaxis was highly effective in reducing the incidence of PONV (only 3/16 patients (18.7%) had PONV symptoms). Patients who were not given any prophylaxis, on the other hand, had a much higher incidence (70%). The results are consistent with the recommendations of the Fourth Consensus Guidelines by Gan et al. (2012) which recommend multimodal prophylaxis with two or more antiemetics from different receptor pathways. This superiority of combination therapy over single agent therapy has also been shown in several RCTs [12].

The most common therapeutic approach in our study was dual therapy (38.6%) and then single drug therapy. This is in line with an increase in the use of risk adapted prophylaxis. Pierre et al. also reported that PONV incidence was significantly decreased by a risk-based approach to antiemetic prophylaxis. Even with prophylaxis however, a significant number of patients still experienced PONV highlighting the multi-factorial nature of PONV and the need for further optimization of protocols [13].

The timing of PONV in our study showed that early PONV (0–6 hours) was more common (20.5%) compared to late PONV (13.6%), which is consistent with previous studies suggesting that volatile anesthetics and intraoperative factors mainly contribute to early PONV. Gan et al. also found that volatile agents and opioids are important anesthetic agents for early postoperative vomiting [14] .

This need for rescue antiemetics in 29.5% of patients in our study further underscores the importance of proper prophylaxis. Those receiving suboptimal prophylaxis (no or single drug) had a greater need for rescue therapy. The results are similar to the study of Habib et al., that found that poor prophylaxis is associated with higher rates of postoperative interventions and longer duration of recovery [15].

Comparing our results with others, the use of multimodal prophylaxis increases effectiveness. Kovac et al. reported that the use of two or more antiemetic drugs of different mechanisms of action leads to better antiemetic prevention than the use of single drugs. Likewise, Watcha and White highlighted the need for the risk stratification approach to achieve the best possible management of PONV [16].

Although these results are encouraging, there is a subset of patients in which PONV persists, meaning that no single strategy is totally effective. There are a variety of factors that can affect results including institutional protocols, drug availability, and differences in patients. In addition, there is a problem with complying with protocols in everyday practice, as stated in the consensus guidelines [17].

In general, the results of the present study corroborate the results reported in the literature. The Apfel

score is an effective tool for risk stratification predicting PONV and multimodal prophylaxis was shown to be effective in reducing the incidence of PONV. The findings support the existing guideline recommendations and emphasize the need for personalized antiemetic management to promote better postoperative outcomes.

Conclusion

Finally, the present study carried out at the Department of Anesthesiology, Shahid Nirmal Mahato Medical College and Hospital, Dhanbad concluded that Postoperative nausea and vomiting (PONV) is still a common complication after general anesthesia and the incidence was 34.1%. The study points to the importance of risk stratification with the Apfel scoring system, where the incidence of PONV gradually increased with the increasing risk categories. Moreover, the results validate that multimodal prophylaxis, especially two or more different antiemetic drugs, is significantly superior to the use of a single drug or none in decreasing the occurrence of PONV. The first 6 hours after surgery was found to be the most critical time for PONV to occur. Although patients were treated with prophylaxis, some still needed rescue antiemetics, suggesting that optimized and individualized treatment strategies were needed. In conclusion, the study refutes the current guideline-based recommendations that highlight risk-based assessment and multimodal preventive measures as key components to impact postoperative results, minimize complications and maximize patient satisfaction.

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